

## **REMARKS**

Reconsideration of this application, as amended, is requested.

Claims 1-3, 5, 6, 8-10, 13-15, 17 and 18 remain in the application. Claims 4 and 7 were canceled previously. Claims 11, 12 and 16 have been canceled with this Amendment. Each of the independent claims also have been amended to define the invention more clearly.

The amended independent claims are believed to distinguish more clearly over the Danielsson et al. reference and over the Danielsson et al./Sauli combination. In particular, the office action quoted from claim 11 of Danielsson et al. to support the position that Danielsson et al. teaches a sheet of an insulating material that has metal clad on both sides. At least one of the metal claddings defined in claim 11 of Danielsson et al. is substantially thicker than the sheet of insulating material. The thicker metal cladding acts as a converter. However, this embodiment of Danielsson et al. clearly requires the metal cladding on one side to act as an electrode and a converter simultaneously, i.e. the electrode and the converter are made of the same material.

In contrast, the amended claims define a plurality of converter devices, each of which has first and second conductive layers disposed respectively on opposite first and second surfaces of an insulator layer. Additionally, each converter device has at least one converter layer arranged on at least one of the first and second conductive layers to define an outermost part of each converter device. Significantly, the converter layer of the amended claims is "formed from a material different than the conductive layer on which the converter layer is arranged." The above-quoted limitation of the amended claims has clear support in the original specification, e.g., paragraph 0040.

The invention defined by the amended claims herein has a significant advantage over Danielsson et al. More particularly, the subject invention permits a converter material to be chosen in view of the specific purpose of the converter device and irrespective of the electrode material used for the GEM foil. Danielsson et al. does not allow such a choice because Danielsson et al. always is limited to the electrode being used simultaneously as a converter. Furthermore, the separate converter layer formed from a material different from the conductive layer on which the converter layer is arranged can produce much greater absorption efficiency.

The greater absorption efficiency achieved with the claimed invention as compared to Danielsson et al. is supported by the Rule 132 Declaration submitted concurrently with this Amendment. The Rule 132 Declaration includes a graph that presents a simulation analysis carried out by the declarant. The three lines in the graph show absorption efficiency for X-rays having energies between 10 keV and 150 keV.

The lowest of the three lines on the graph depicts simulated absorption efficiencies of a conventional GEM foil having copper electrodes with thickness of 5 micrometers. One of the copper foil electrode simultaneously acts as a converter layer.

The middle of the three lines in the graph simulates a GEM foil having a copper converter applied on top of one of the copper electrodes of the GEM foil. The additional copper converter layer was simulated to have a thickness of 5 micrometers. Thus, a 10 micrometer thick copper layer (5 micrometers electrode, 5 micrometers converter) exists on one side of the converter device simulated by the middle of the three lines. Accordingly, the converter device depicted by the middle of the three lines on the

graph simulates the Danielsson et al. claim 11 embodiment that was mentioned by the Examiner in the office action.

The upper of the three lines shown in the graph corresponds to the claimed invention. In particular, the upper of the three lines simulates a converter device with a convention GEM foil and a converter layer formed from a material different than the copper conductive layer of the GEM foil. In the third simulation, the converter layer is gold while the electrode is copper. Gold was considered by the declarant to be an appropriate converter for X-ray detection and hence was considered to provide a meaningful comparison to Danielsson et al. The graph of these three simulations clearly shows that the claimed invention provides very significantly enhanced absorption efficiencies as compared to both the conventional GEM foil and as compared to Danielsson et al. In this regard, the Examiner will appreciate that the vertical axis of the graph is a logarithmic scale. Accordingly, the upper line in the graph demonstrates an absorption efficiency that is as much as ten times greater than Danielsson et al.

Contrary to the assertions on page 10 of the office action Sauli does not teach cascading a multiplicity of converter devices. Rather, Sauli teaches that such cascading is not possible. In this regard, the Examiner's attention is directed with respect to col. 21, lines 53-57 of Sauli where Sauli explains that "the detection unit may well include another gas electron multiplier so as to form a multi-stage gas electron multiplier." Sauli does not suggest adding another converter layer, such as a photocathode. Rather, it is clear from Sauli that another photocathode layer is completely pointless, since no photons can pass through the first photocathode layer having "an optical transparency close to zero" (col. 23, lines 34-35).

Furthermore, Sauli discusses the influence of secondary photons. It should be pointed out that secondary photons are photons that should not be detected. Secondary photons have a negative influence on the detection signal, and effectively constitute noise. Moreover, secondary photons are generated by recombination processes which occur locally after the first GEM structure having a photocathode thereon. More particularly, secondary photons typically occur in the gap between the first and the second GEM foil (and in the gap between the neighboring further GEM foils). Hence the second GEM foil of Sauli is not provided with a photocathode. This is consistent with the argument of Sauli that

"secondary [photons] in the second stage element cannot heat the photocathode layer PhC thereby preventing to induce secondary emission" (column 23, lines 29 to 31).

The negative influence of secondary photons due to heating of the photocathode layer is discussed in detail in "Advantages in Gas Avalanche Photomultiplier" by Breskin et al., dated June 1999, a copy of which is submitted concurrently with the Information Disclosure Statement filed concurrently with this Amendment. In particular, section "4. Electron Multipliers" on page 6 of this publication refers to FIGS. 8 to 10, and asserts that the GEM

"would transmit photoelectrons into the multipliers, while screening the photocathode from avalanche-induced feedback photons".

The "avalanche-induced feedback photons" represent the secondary photons, referred to by Sauli. Moreover, page 7 of Breskin et. al. publication states that

"almost complete elimination of photon feedback effects in multi-GEM structures permits, for the first time, reaching very high gain". Even more, "the deposition of a photocathode on

top of the GEM surface (figure 11) should permit an operation free of photon feedback effects".

Clearly, the Breskin et al. publication draws the same conclusion as Sauli, namely that a photocathode layer can only be arranged on the topmost face of a detector device having a plurality of converter devices. This is exactly the statement that Sauli makes and entirely teaches away from the present invention.

Following that, when combining Sauli and Danielsson et al., Sauli teaches to avoid heating of the converter layer by arranging a converter layer exclusively on the topmost multiplication stage followed by a plurality of pure multiplication stages with no converter layers. Further, Sauli teaches that consecutive arrangement of converter devices would lead to unavoidable heating of the converter devices, thereby teaching the person of ordinary skill that heating by secondary photons is to be avoided.

Danielsson et al., on the other hand, provides different ways of cascaded converter devices. In particular, Danielsson et al., teaches that cascaded converter devices have an electrode used as converter device. However, taking into account Sauli, the person of ordinary skill would realize the disadvantage of such an array and, rather, would provide no further converter layers in the consecutive amplification stages (according to Sauli) or would provide any of the further arrangements of converter devices according to Danielsson et al., such as the one shown in figure 7a of Danielsson et al., which would avoid heating of the converter device by protecting it from impact with secondary photons due to the arrangement of the converter device in the core of the structure.

However, the inventors found out that the conclusion drawn by Sauli is not valid. Particularly, the inventors found out that cascading a plurality of converter devices,

each having an individual converter layer, is indeed very practical and that heating of the converter layers due to the secondary photons is neglectable.

In summary, the invention defined by the amended claims herein is not taught or suggested by the hypothetical combination of references relied upon in the latest office action. To the contrary, a person of ordinary skill in the art would be led away from the subject invention due to the deficiencies pointed out in Sauli. As a consequence, the subject matter of the amended claims herein is not suggested by the hypothetical combination of references relied upon in the office action. Accordingly, the claims are believed to be patentable and issuance of a Notice of Allowance is solicited. The Examiner is urged to contact applicants attorney at the number below to expedite the prosecution of this application.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Gerald E. Hespos", is written over the typed name.

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